Changing the Arctic: Adding Immediate Protection to the Equation

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The Arctic represents a region of the globe directly affected by climate change, human disturbance and natural variation. In addition to acting as the global weather machine, it is considered one of the last remaining "wilderness" areas. However, the warming of the Arctic, a prospect of an ice-free maritime route across the top of the world, and the International Polar Year (IPY), have piqued an interest in the Arctic not previously seen. Prospects of shipping routes, tourism, oil and gas development, and new commercial fisheries have started a "land rush" by various nations to claim a piece of the northern oceans. The Arctic is in danger of being given away piecemeal as each nation asserts claims and then rushes to develop or exploit their territory to aid in establishing ownership.

A wider public discussion on the protection and management of this unique zone has not happened, and despite, or perhaps because of, globalization, protection is still difficult to implement. So far, if at all, only haphazard conservation measures have been considered. Most lack either focus, enforcement, or a performance review. The recent listing of polar bears in the U.S. is a prime example, and Alaska is in the process of appealing the listing for fear protection will interfere with oil development and related transportation in the Alaskan Arctic. Other species in decline include the ivory gull, thick-billed murres, Kittlitz's murrelets, some eider duck species, various shorebirds, and Arctic cod.

Many other crucial components of the Arctic biodiversity have not even been assessed, calling for the Precautionary Principle, as promoted by the International Union for Conservation of Nature. Science-based adaptive management, a management method widely suggested to attain sustainability, had not really been applied to the Arctic. In this article we describe and assess the existing protection schema, and the pros and cons of increased protection in the Arctic, as well as how it links with global sustainability in monetary, biodiversity, and other terms. We are in a strong position to do this assessment because we were able to assemble over 45 data sets in a consistent format and as GIS layers for the entire circumpolar Arctic (*see Figure 1*).

So what would be the best level of protection for the Arctic and how would this be accomplished? With the Antarctic Treaty for instance, half of the polar regions have basically been protected for decades. In contrast, few Arctic conservation zones exist, and they were virtually derived ad hoc, without any relevant principles of global democratic governance and management practices. There has consistently been a history among nations of protecting 'rock and ice', and most current protected areas within the Arctic are of this type. If individual nations are each left to decide the level and area of protected areas, this concept would likely be the case for any future mandated protection. Many decisions were made without proper data and driven by specific agendas. Promotion of economic growth and nationalism have driven manage-

ment decisions in the Arctic rather than a global consideration of biodiversity, indigenous people and potential ecological services. As more development occurs, protection appears to continue to be an ad hoc process that protects an area with no perceived economic value. This is also true if protection is mandated to a certain percentage of the overall Arctic, or of each country's territory (the Rio Convention figure is a meager 10%). It is known from elsewhere that a small fragmented network of conservation features does not meet protection goals. We would like to put forth the concept of considering the Arctic as an entire ecosystem which takes long-distance migration and energy flows into account, and propose the proper use of Strategic Conservation Planning to implement conservation plans on an international level before wholesale development of the Arctic begins.

As an example of such strategic planning, we propose using a MARXAN optimization modeling analysis (*see Figure 2*). MARXAN has been widely applied in many countries and types of marine ecosystems for creating marine protected areas (MPAs). Using some basic scenarios, the model helps find the best available distributions of protected zones given the specified inputs for each scenario to satisfy the greatest number of stakeholders. Data used in the model were taken from various research publications that mapped ranges of arctic species, oceanic conditions, and human impacts in the Arctic, for a total 45 circumpolar GIS layers.

Number	Data Set Name
1	Coastline
2	Bathymetry
3	Human Settlements
4	Mean Ice Cover
5	Sea surface salinity
6	Sea surface temperature
7	Phosphate concentration on sea surface
8	Silicate concentration on sea surface
9	Ocean currents
10	Bioclimate zones
11	Arctic physiological zones
12	Travel- and Shipping routes
13	Current areas of interest to fishing industry
14	Future areas of interest to fishing industry
15	Predicted distribution of Zooplankton (Calanus glacialis)
16	Predicted distribution of Zooplankton (Calanus hyperboreus)
17	Predicted distribution of Zooplankton (Metridia longa)
18	Predicted distribution of Zooplankton (Metridia pacifica)
19	Treeline
20	Areas of interest to Oil & Gas Exploration
21	Bearded Seal distribution
22	Ringed Seal distribution
23	Known Ringed Seal pup sites
24	Narwhale distribution
25	Walruss distribution
26	Polar Bear distribution
27	Orca distribution
28	Beluga whale distribution
29	Known Beluga autumn concentration sites
30	Known Bluewhale migration corridors
31	Known Finwhale migration corridors
32	Land area
33	Known marine biodiversity hotspots (ArcOD)
34	Known Arctic biodiversity hotspots
35	Large Lakes
36	Major Rivers
37	Muskoxen distribution
38	Ivory Gull distribution
39	Major Thick-billed Murre colonies
40	Protected Areas
41	Known Bird flyways
42	Sites of known nuclear pollution
43	Sites of known Caesium pollution
44	Sites of known PAH pollution
45	Planning Units (100km)

Figure 1. (Left) List of Circumpolar Data Sets compiled by the authors and that inform the Marxan runs of this investigation.

A) 20% Viable Seabirds & Habitats
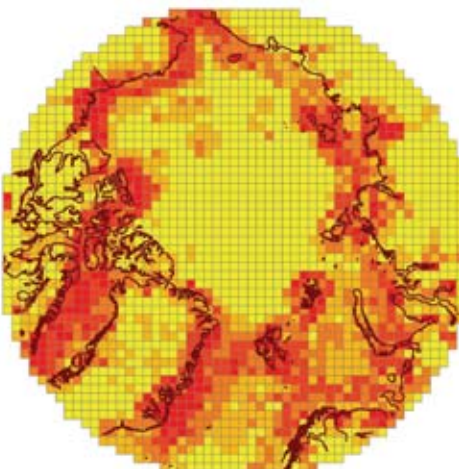
B) 10% Economy & Ecology Compromise

Figure 2. Scenario results of a MARXAN run for the optimization of (A) protection of seabirds (ivory gulls and thick-billed murres) and their relevant habitats, and (B) 10% compromise between general economy and ecology. Red cells indicate highest priorities to achieve goals.

However, such tools are only a first step and require further fine-tuning, approval and use by various governments, stakeholders and legislation. We would highly welcome a wider public discussion, challenge and update of our modeling work. It is extremely likely that developing the Arctic will involve the loss of species, habitats, and sustainability detrimental to existing legislation. We are proposing that the real legacy of the International Polar Year is indeed a protected circumpolar park that achieves the larger sustainability goals in the framework of adaptive management. Science-based adaptive management of Arctic resources can only be achieved when based on sound and mutually accepted data. Such a database, presented at a central web portal, still needs to be assembled and constantly be improved. It can only go hand-in-hand with high-quality monitoring efforts that feed into such efforts and link directly with policy.

We conclude that an immediate large-scale protection (e.g. over 30%) of Arctic resources is warranted, and that the business as usual outlook in the mid- and long-term future will be devastating for most Arctic resources and playing a role in destroying global resilience. Thus, adding protection to Arctic management is not only a best professional practice, in full agreement with the original sprit of the conservation laws, but an inherent part of a global survival strategy.